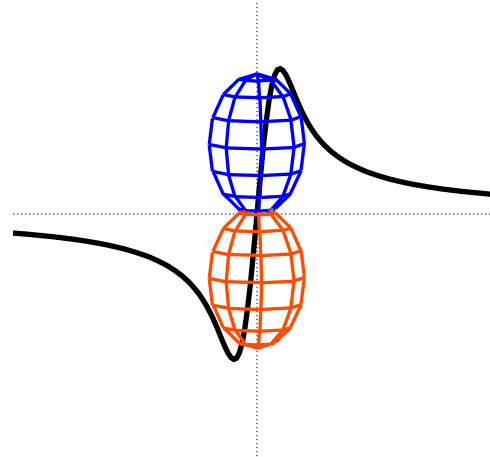


Quest for a new working point in RHIC

R. Tomás

BNL



June 9, 2004

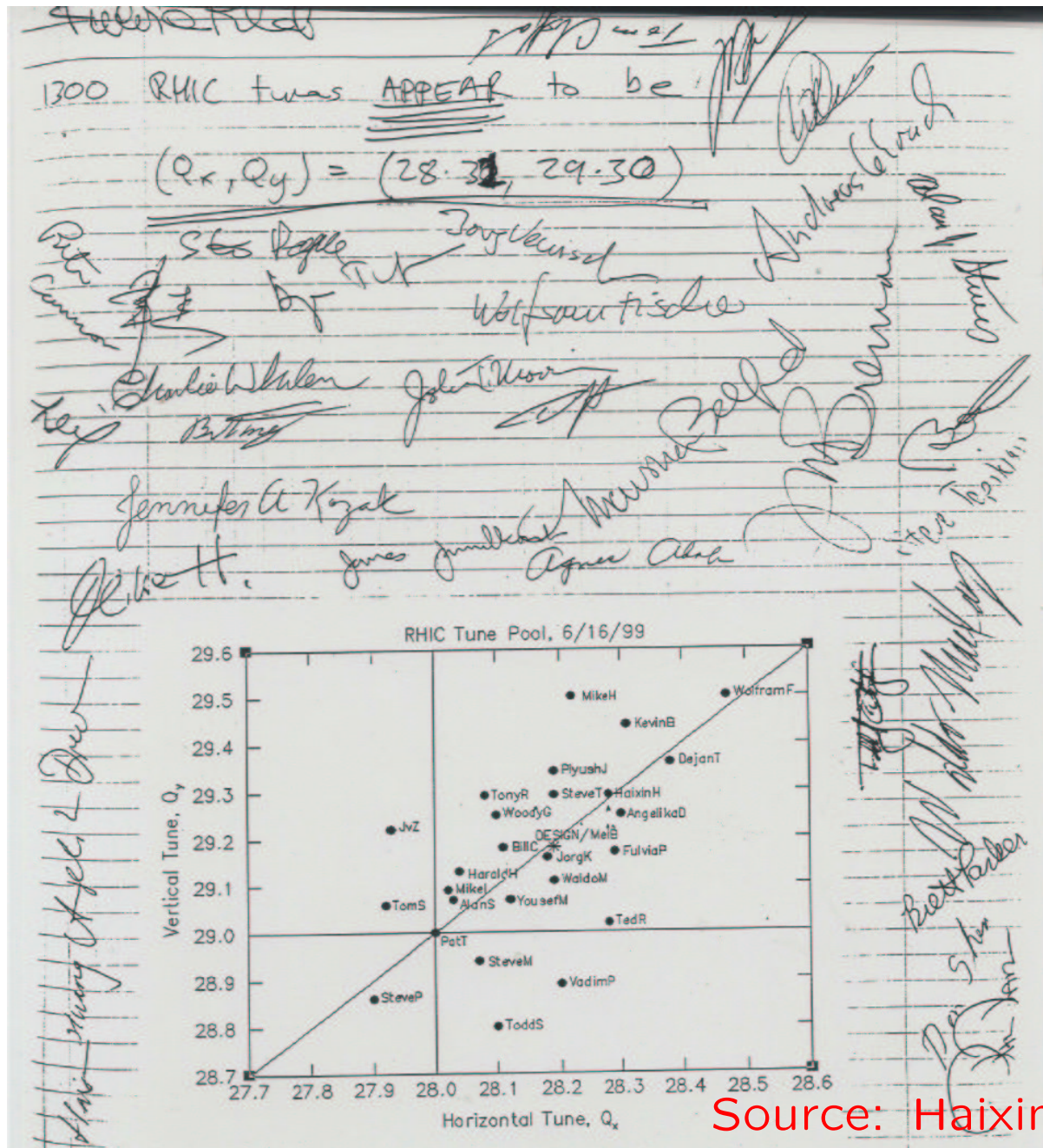
All the people that worked on this

1

-
- The shift leaders: Angelika, Christoph, Dejan, Fulvia, Gregg, Haixin, Mei, Rama, Todd, Waldo, Wolfram, Vadim, Yun
 - Very important support: Thomas, Steve T. & P., Johannes, Frank S., ...
 - Operations and Controls groups
 - The PLL: Pete, De la Pena, ...
 - Polarization lords: Gerry, Osamu, ...

Earlier quests for tunes...

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Contents:

- Need of a new working point?
- Gold experience & simulations at store
- The Proton run

Need of a new working point?

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The RHIC proton-proton performance is limited by the beam-beam effect. May other working point alleviate this effect?

Hadron collider tunes (accommodated for pp collisions):

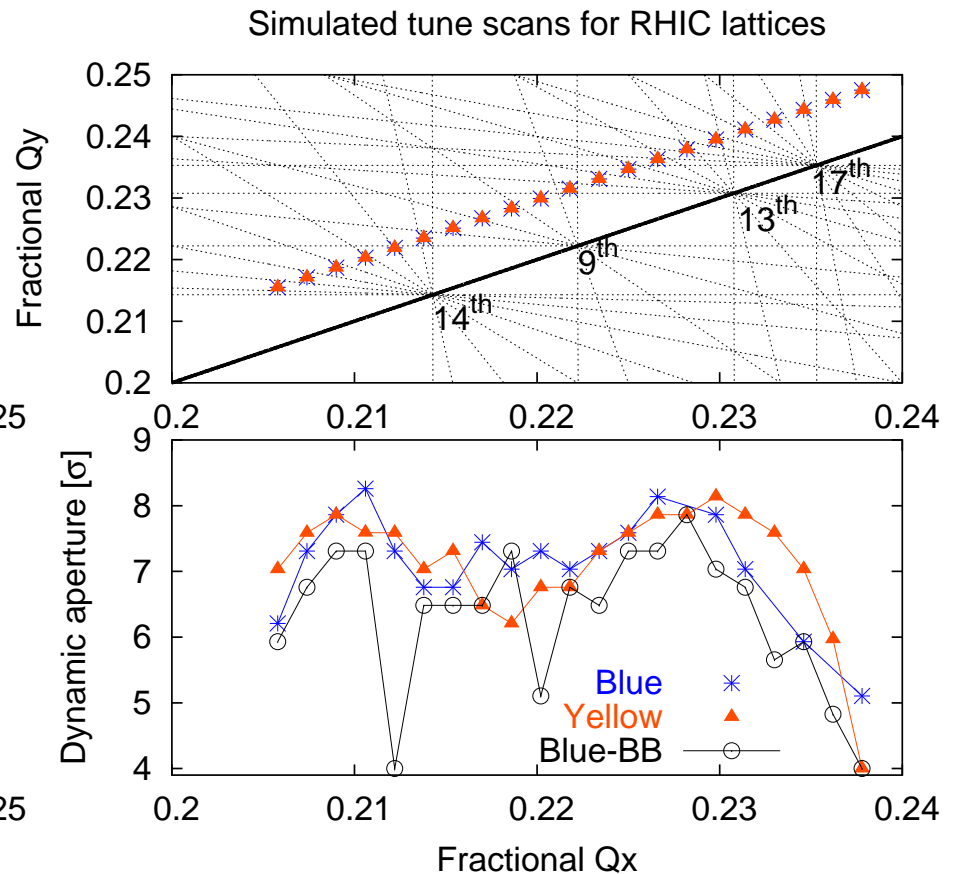
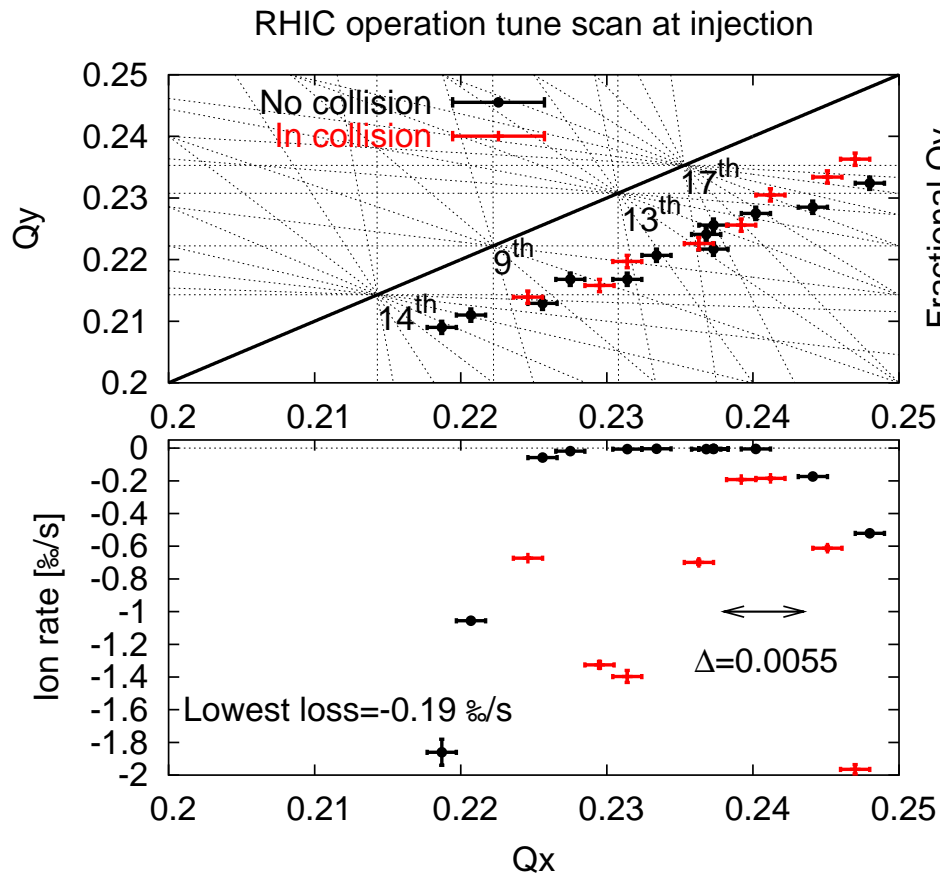
| <i>Ring</i> | <i>Q_x</i> | <i>Q_y</i> | <i>Resonances</i> | <i>Spin?</i> |
|-------------|----------------------|----------------------|-------------------|--------------|
| RHIC design | 0.19 | 0.18 | 5,6,11 | OK |
| RHIC oper. | 0.235 | 0.225 | 4,9 | OK |
| HERA-p | 0.292 | 0.298 | 7,10 | No |
| LHC | 0.31 | 0.32 | 3,10 | OK |
| Tevatron | 0.578 | 0.59 | 2,7,10,11 | No |
| ISR | 0.955 | 0.93 | 10,11 | No |
| SPS | 0.685 | 0.68 | 3,10 | OK |
| RHICpp_04 | 0.735 | 0.73 | 4,7,11 | OK |

- Measurement of beam lifetime vs tune (hint: beam-beam does not depend on the energy, therefore we can easily experiment at injection energy!)

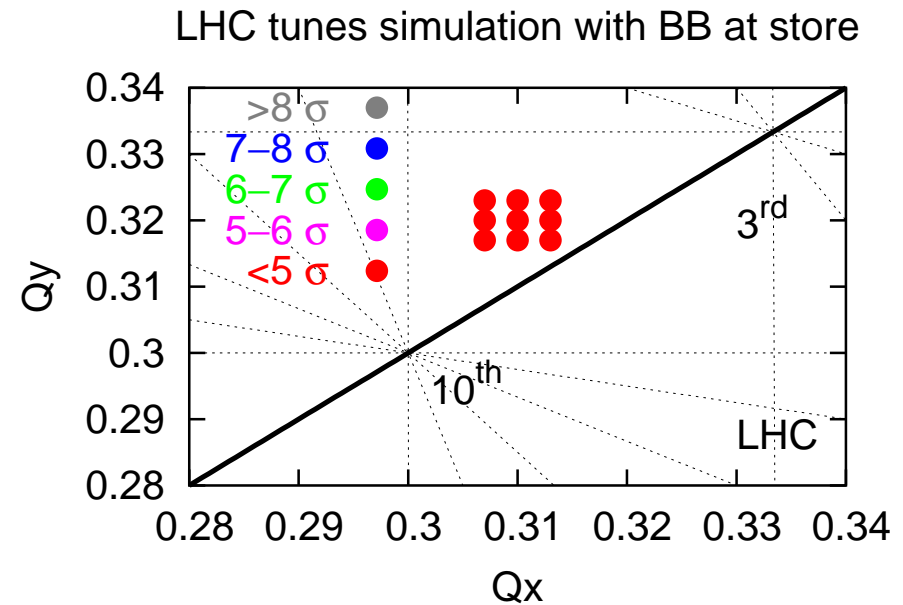
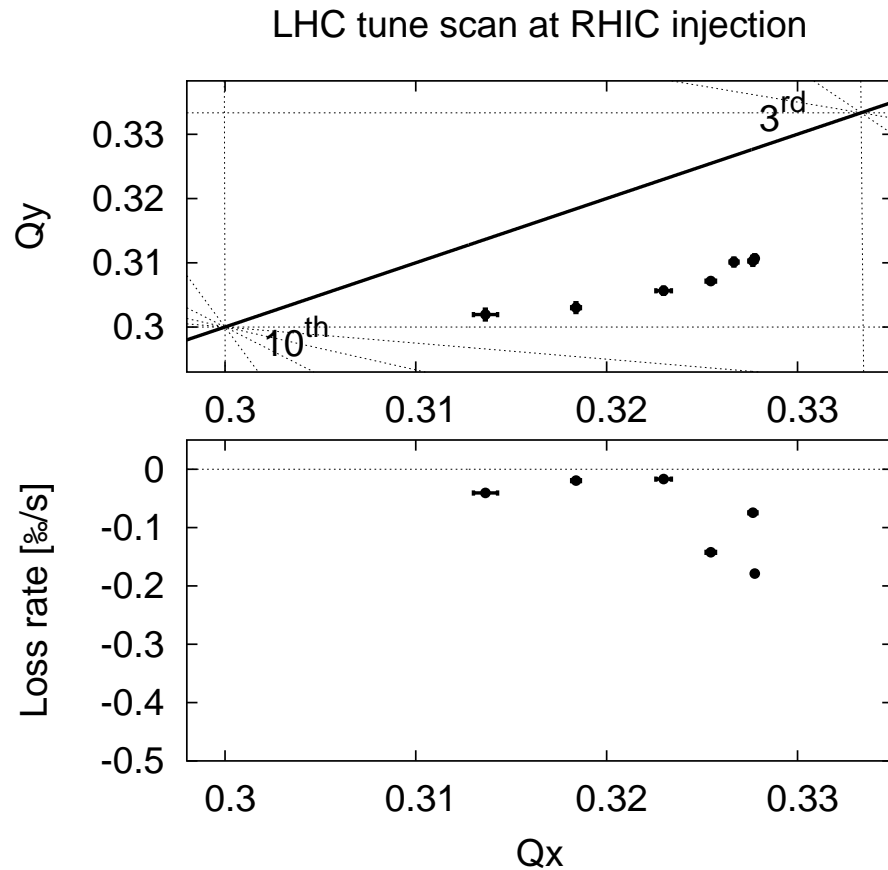
$$\xi_{x,y} = \frac{Nr_0}{4\pi\epsilon_N}$$

- Simulations: computation of the Dynamic Aperture using the weak-strong approximation (at top energy there are strong non-linearities)

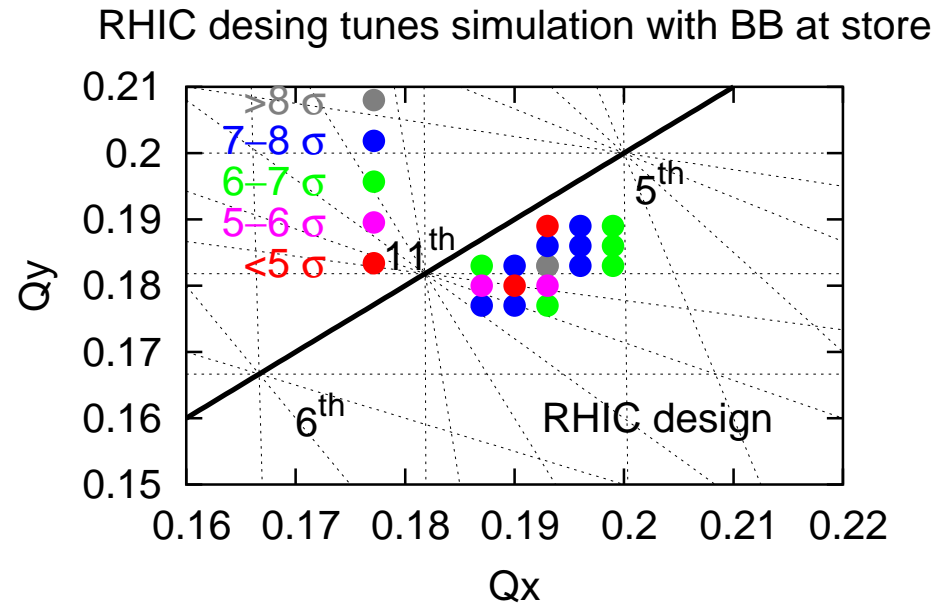
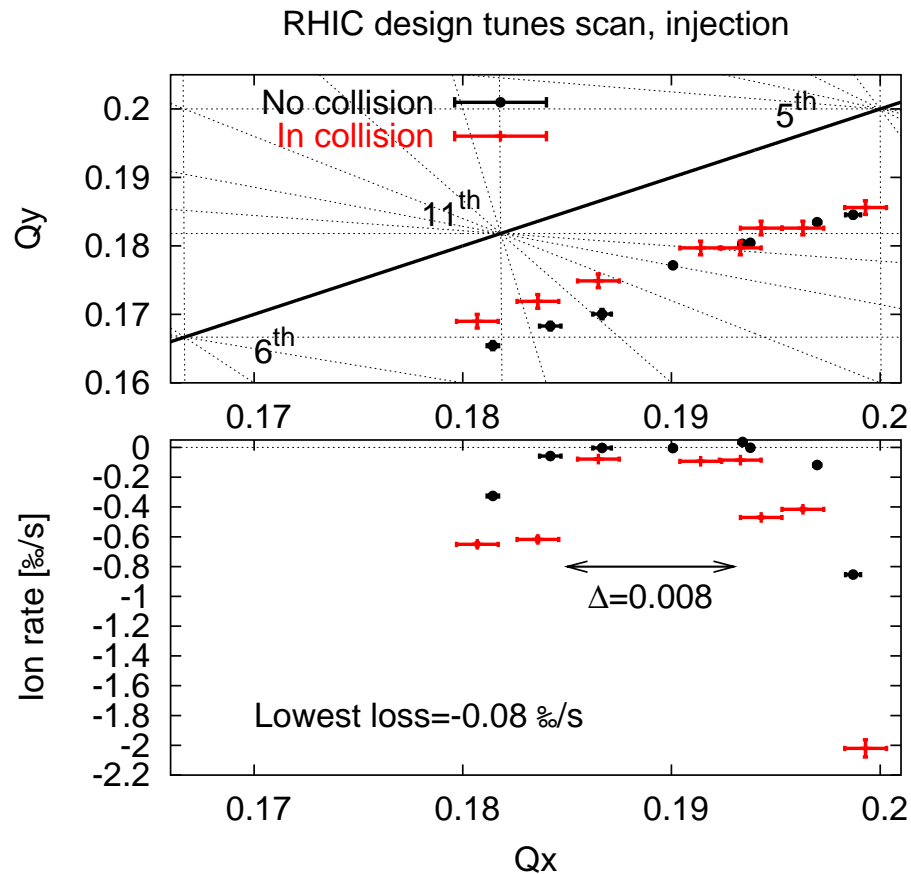
Gold experience & Simulation: RHIC operation 6



- Very good at injection but sensitive to beam-beam. DA at store with BB smaller than 8σ .

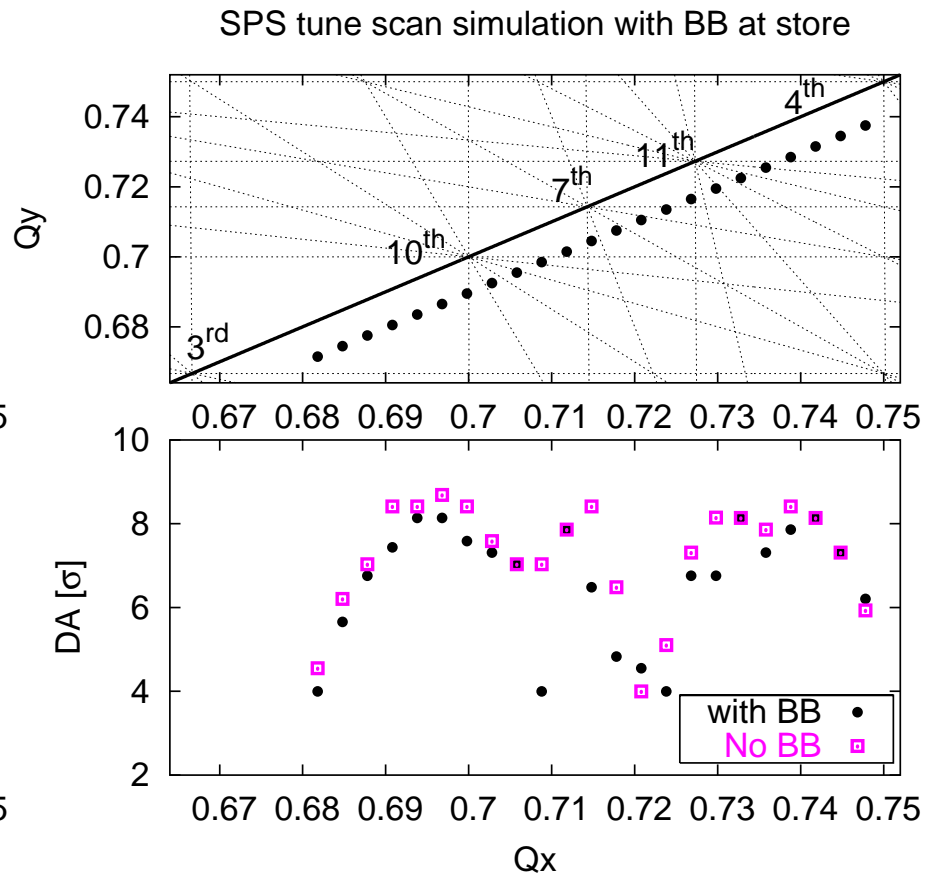
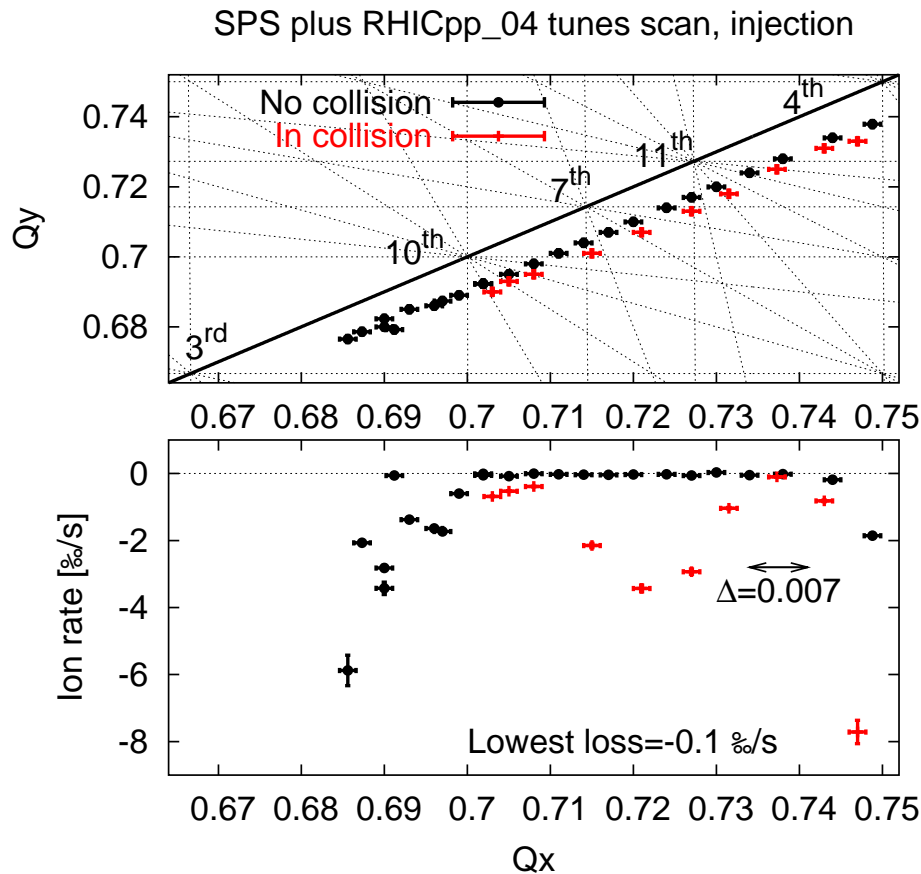


- Good at injection but catastrophic at store with BB



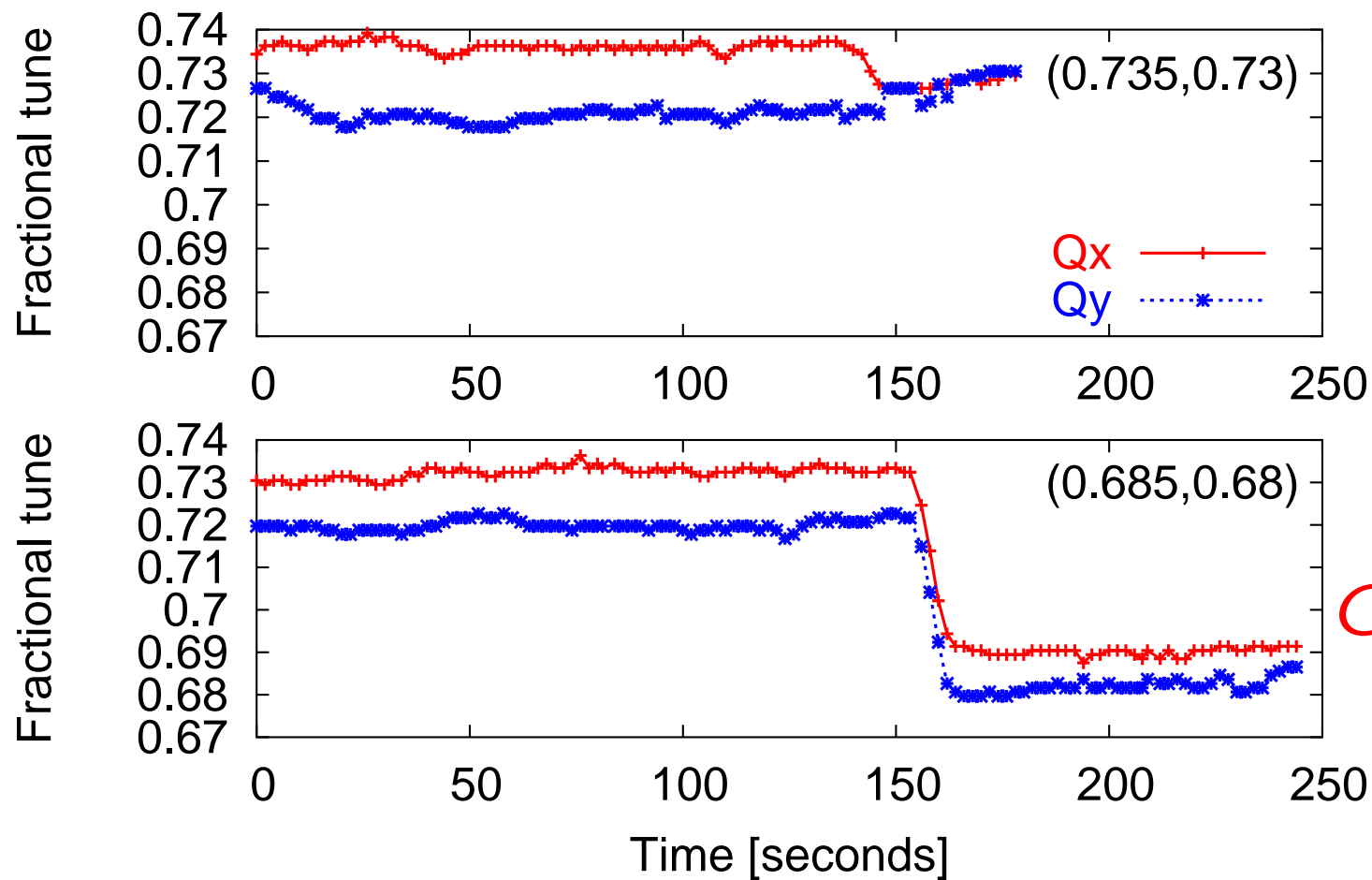
- Very good rates at injection but small window for operation. DA at store larger than 8σ

Gold experience & Simulation: SPS & RHICpp 9



- SPS: Impossible injection but DA at store larger than 8σ .
RHICpp: Good at injection, at store $DA > 8\sigma$

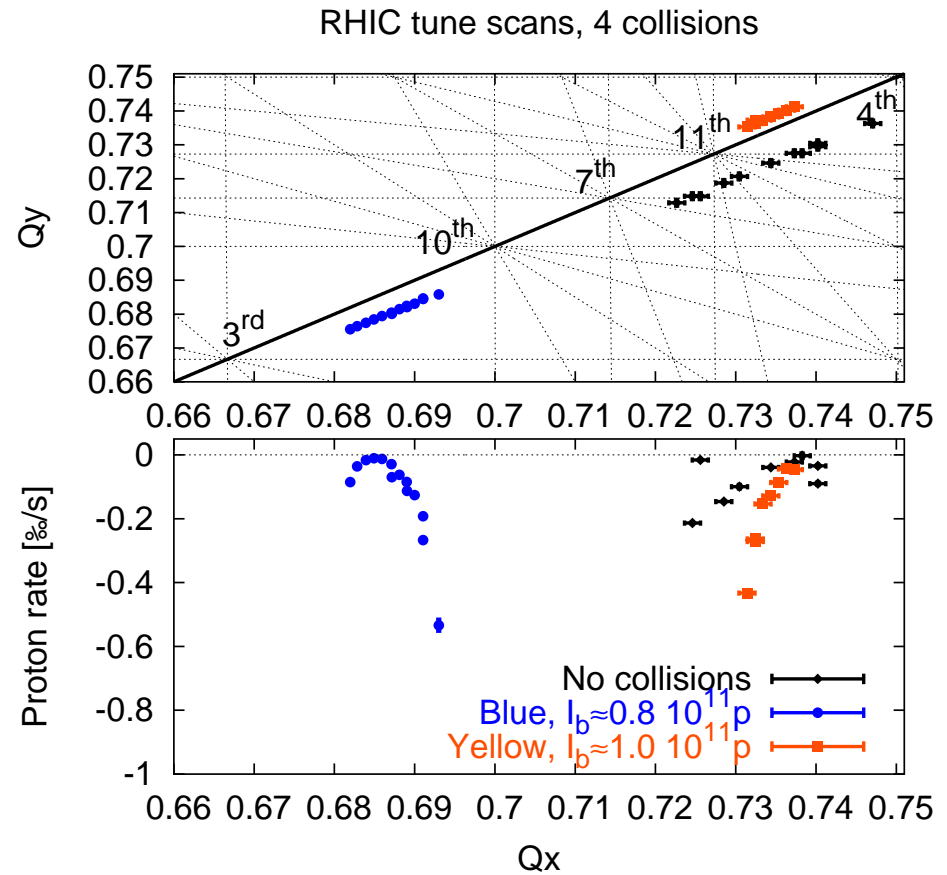
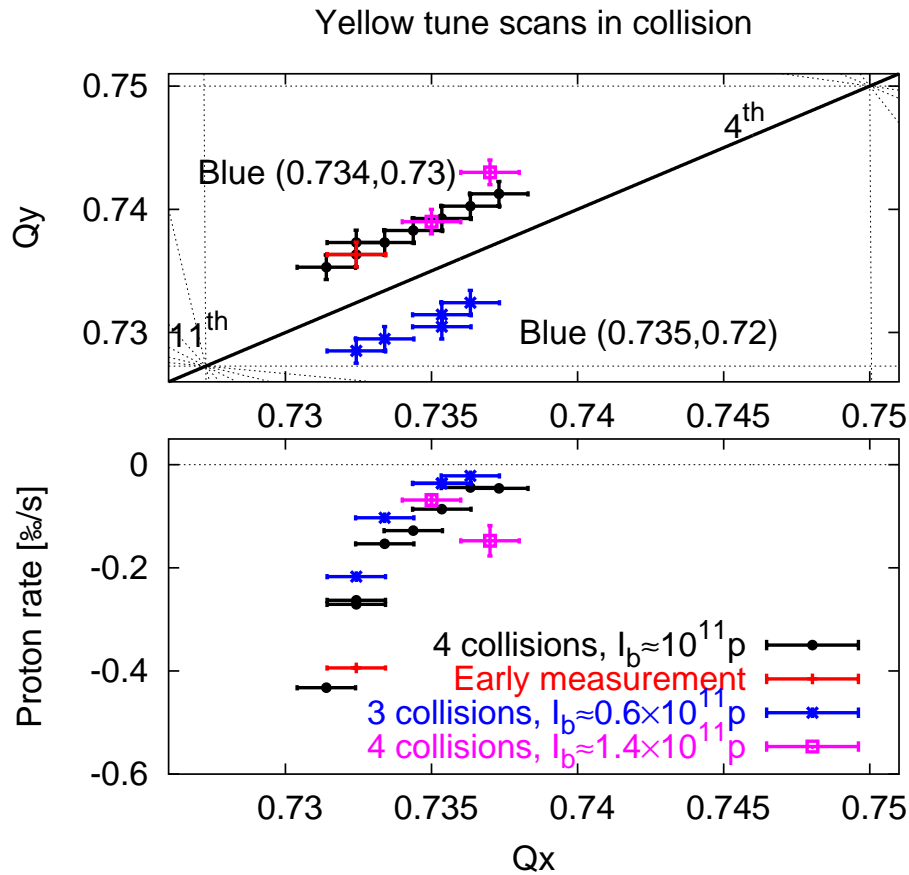
Tunes during energy ramps for the two working points



Chapeau!

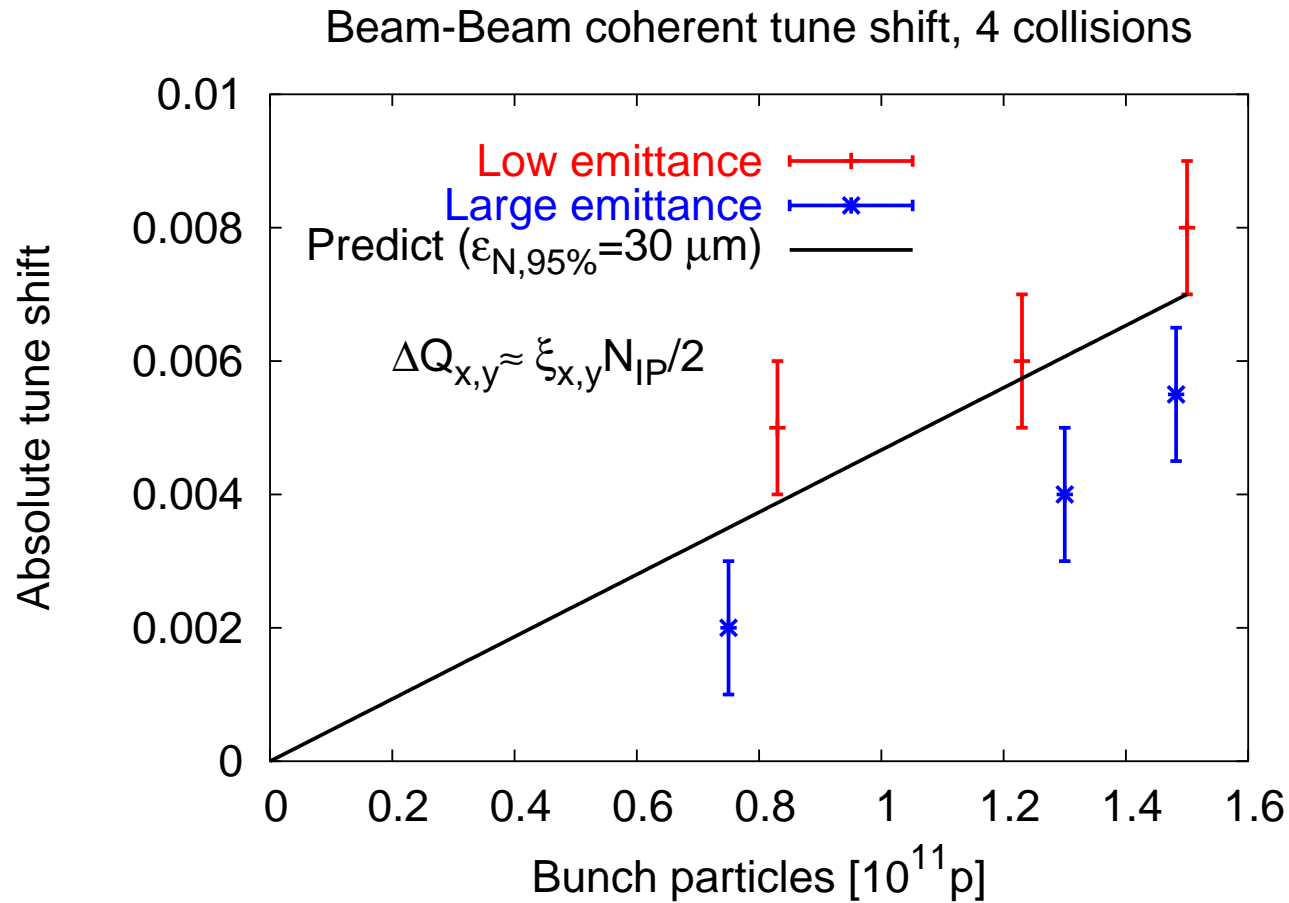
The PP run

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- SPS tunes look slightly better than RHICpp. Polarization also prefers SPS tunes.

(PLL and Artus beam-beam tune shift measurements agree)



\Rightarrow Achieved peak luminosity $\approx 10^{31} \text{ cm}^{-2}\text{s}^{-1}$

- Keep SPS tunes at store
- Push the beam-beam limit (this was done only for RHICpp)
- Correct the third order resonance to be able to inject at SPS tunes